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ABSTRACT

This brief overview of the state of the art in computer education in schools in the Federal Republic of Germany covers both the extent and areas of use and research and development, and frequent comparisons are made with educational computer usage in other countries, including the United States, Japan, France, Great Britain, and Norway. The curriculum for computer education in upper secondary schools, which is called Informatics and corresponds to computer science in the Anglo-Saxon world, is then described, and it is noted that all schools at this level have been equipped with computers. The current status of computer education in grades 5 through 10 is also described, including the educational orientation and curricular guidelines. Three reasons why programming is not considered a central focus for students at this level are discussed: (1) user software and software tools make personal programming for the majority of the population superfluous; (2) students do not have enough time for training and practice; and (3) programming courses cannot be required with the idea that they promote cognitive development. It is noted that there is very little going on in computer education in West German primary schools. A brief review of computer usage, including comparisons with activities in other countries, and an outline of areas of research that are of special interest to West Germany conclude this paper. Two graphs compare computer usage and non-usage in six countries, and the bibliography lists 26 sources in German and 2 in English. (BBM)

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Karl Frey: Microcomputer Applications in Education - A Report-in-Brief About Current Issues and Approaches in the Federal Republic of Germany

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TO THE EDUCATIONAL RESOURCES

In April 1985 the Atlantic Institute for International Affairs conducted a representative study in the USA, Japan and six European countries (France, the Federal Republic of Germany, Great Britain, Italy, Norway and Spain). This study makes no statement about the state of the art in research and development in computer education. It does, however, give an informative description of the populations' experience with, interest in and comprehension of the computer.

In the USA 37 % of the population have used a computer or a word processing system (see Table 1). The percentage is distinctly lower in all the European countries. In the Federal Republic of Germany, Italy and Spain the percentage is between 7 % and 12 %. The percentage in France, Great Britain and Norway is about double that of the other three European countries in question. The higher percentage in France and Great Britain is surely due to the governments' extensive campaigns, in Great Britain due to the BBC's engagement and the Sinclair phenomenon, in Norway due to the constant expansion of Norsk Data, a computer company, which economically has a symbolic value for a country with so few inhabitants. A universal factor to explain the differences in Europe is nonexistent. It does not appear that less computer experience results from limited availability of computers. Not everyone is interested in learning how to use a computer (see Table 2).

A comparison of the three big economic powers, the USA, Japan and the Federal Republic of Germany, proves interesting. Japan and the Federal Republic of Germany come after the USA as economic powers and in both countries the use of computers is limited. Even in the "Computer Country" Japan the percentage is only 14 %. That surprised me and was food for thought, as we generally like to speak of the economic benefits when formulat-

ing aim and claims of computer education. The authors of "A Nation at Risk" and numerous other groups have an eye on the economic competition coming from Japan and demand computer courses for the entire population. This also holds true for politically oriented groups in Europe. They believe that it is the way to create a basis for the production and dissemination of advanced information technologies. Obviously public education in Japan does not correlate with Japan's position on the world market.

Measures such as those in France, Great Britain and Norway stimulate the home market. The state of research, development, production and share of the world market, on the other hand, are not influenced to any appreciable degree, neither is the economic standing of the country. A study by Hecht (1977) shows that of all the pupils completing the Gymnasium (corresponds to high school diploma plus two years, i.e. completion of junior college) who had to take courses in each of the sciences taught, only 10 % went on to do something connected with science (medicine included). Another factor is also important: When young people in industrialized countries are required to take science courses for a number of years, their interest declines. Possible aversion increases (see Lehrke, Hoffmann, Gardner 1986). The examples used by the World Bank, where educational measures support the achievement of economic goals, are, as far as I know, from earlier agricultural and developing industrial structures. If, for example, a farmer was taught about fertilizers the later crops yielded more.

Given the current integration density in microelectronics, completey different measures affect the economic structures. Two years ago the multinational Siemens (Federal Republic of Germany), together with Philips (The Netherlands), decided on a joint investment of several bilion in producing the next but one generation of microchips in Europe (and if possible before

the Japanese). A step of this nature has an economic influence. The same cannot be said of a program of compulsory computer lessons in which all secondary school students would be required to learn BASIC, Word 2000 or how to use a Macintosh mouse.

2.
Some curriculum experts in the Federal Republic of Germany have recognized this and have attempted to avoid causing an economic upswing by means of the computer. They have attempted to develop curricula according to educational considerations. Some ministers of education and of economic affairs maintain that they sponsor computer education in order to advance the economy. They receive support from one quarter indirectly and quite unintentionally. In Great Britain there is the BBC-Acorn Computer which has been developed for educational purposes. In the schools in the Federal Republic Germany, on the other hand, there is only equipment from Commodore C4, Apple, Siemens or IBM in use which has been developed for offices and homes. The same is true for the software such as Word or Pascal. The hidden curriculum is unintentionally directed towards business. Otherwise the curricula are developing in completely different directions.

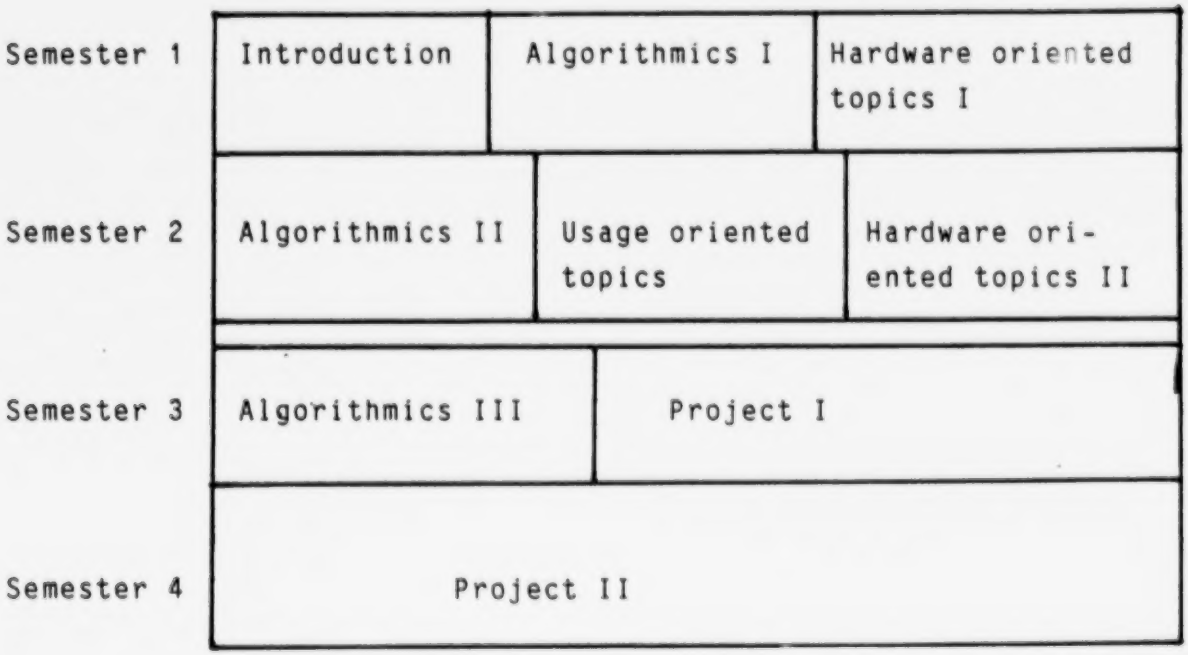
In the following I will attempt to characterize the individual areas.

First the upper secondary school, the German Gymnasium which is high school plus the first two years of college. At this level practically all the schools are equipped with computers and an official state syllabus released three years ago. It is fair to say that Germany was the first country worldwide to fully provide all schools with a curriculum and equipment for computer education. The subject is called "Informatics" and is similar in its structure to the university subject "Informatics" which

corresponds to "Computer Sciences" in the Anglo-Saxon world. There are 3 periods a week for informatics in grades 11 to 13.

The following scheme shows the structure of this curriculum.

Informatics Syllabus



The leading textbook is "Metzler Informatik" written by Harbeck, Bosler, Buhse, Moll, Schlichtig, Thode and Wilms comprises a 400 page pupil's textbook, a 300 page teacher's manual and a special volume for computer languages (BASIC, Pascal, Oxford, UCSD Pascal, Turbo Pascal, Elan and Comal).

Despite the strong orientation towards the university discipline, the hardware plays a minor role compared to the 60's where computers were mainly dealt with in physics under the perspectives of electrical engineering (semi-conductor, logical

connections). Curricular innovations at the upper secondary level were usually preceded by research on suitable programming languages (Logo, Pascal, BASIC) for schools. Hardware configurations were also tested (see Schulz-Zander, Bosler, Hansen, Lehrke 1983 and Schulz-Zander 1986). The experiments were, however, not accompanied by achievement tests. Learning psychology investigations were mostly ignored. This had to do with the fact that in conferring pilot and innovation projects empirical evaluation was not required at the end as it was in most Anglo-Saxon countries.

3.

The grades 5 through 10 are characterized by a very heterogeneous picture. All ten states and West Berlin require computer courses in school. The school requirement is, however, not yet complete. The states and the Federal Minister of Education have passed a joint platform on "education in information technology". This 20 page paper sketches clear educational orientation and curricular guidelines. They emphasize:

- that the pupils themselves should be able to work at the computers,
- that the pupils should be able to make use of the computer in areas that concern themselves personally,
- that they should be able to understand and know the principles of hardware and software,
- that they should also be concerned with the individual and structural changes in the structure of communication and in their place of work.

The importance of algorithmic procedures is also mentioned, but not as being the most important. The same is true for programming. Pupils experience positive feedback when they program the computer themselves and it carries out their instructions. At the beginning, success in programming is pedagogically very important, especially in today's schools that are so selection

oriented. Still the compulsory schools in the Federal Republic of Germany do not consider programming a central point for the following three reasons:

First, current and future offers of user software and software tools make personal programming for the majority of the population superfluous. Even if, according to European estimates, 70 % of the working population have to do with information technology, not even 10 % of this 70 % will do their own programming.

Second, becoming a good programmer requires so much time for training and practice that the compulsory schools in the Federal Republic of Germany with their strict division of subjects do not have the time at their disposal.

Third, programming courses cannot be demanded with the idea that they promote the general ability to bring forth higher cognitive achievement (see e.g. Pea, Kurland 1984); Mandl, Hron 1985).

Thus, computer education in compulsory schools differs greatly from the courses at upper secondary level. There programming and conducting projects is of great importance (see as example Buhse 1983, Müller 1985).

There is, however, one exception in the compulsory schools. West Berlin and several federal states offer non-compulsory courses (electives) for grades 8 to 10 with three periods a week that are similar in construction to the upper secondary level curriculum. The idea is for the pupils to carry out their own projects from the second year onwards. The pupils receive a list of areas in which they can analyze, structure, algorithmically set up, program a complex field and realize it on the

computer over a period of several months (see e.g. the reports in Arlt, Haefner 1984, Koerber 1978, Frey 1982).

4.

In primary school, grades 1 to 4 or 5, there is very little going on in the Federal Republic of Germany. There are a number of schools using computers, but on their own initiative. Some professors in teacher education are experimenting. It is not comparable with the research and development efforts in, for example, France at the Centre Mondial. On the other hand, developmental work on the use of computers in special schools has reached a relatively high level.

5.

If I were to carry this international comparison further, then I could make the following observations as a summary:

- At upper secondary level (grades 11 to 13) the Federal Republic of Germany was the quickest worldwide to have a set curriculum with a national supply. Research and pilot project evaluation played a subordinate role. The curriculum was set up along the lines of the university subject "computer science".
- Some compulsory schools plan computer education for grades 7 to 10, at least in North Rhine-Westphalia and some other states with emphasis on user software and taking into consideration all aspects of computers, including data protection and the changes in work.
  In addition there is a two to three year non-compulsory course (elective) with three periods a week which is based on the upper secondary level curriculum.
- Grades 1 through 6 are fairly "white",i.e. empty of computer education. There are no political initiatives to start measures at this level soon.
- In comparison to the U.S.A. programmed learning practically has no chance in reaching certain achievement. There is no

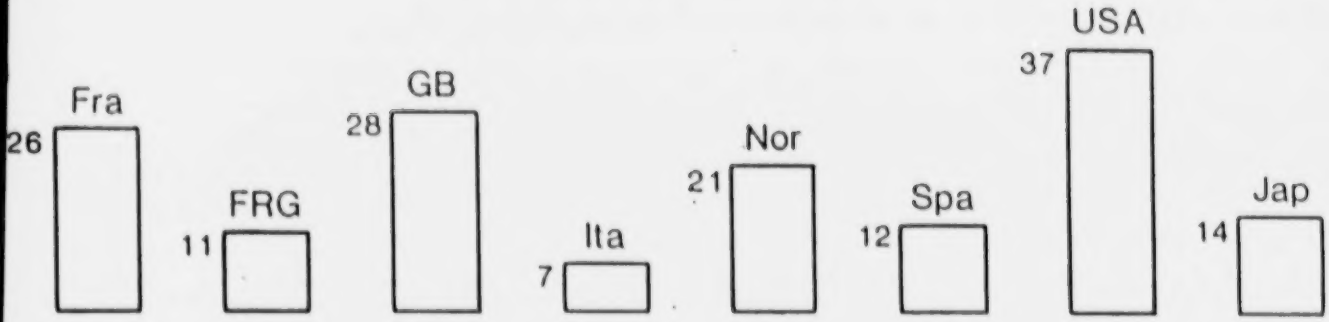
pronounced tradition for "drill, practice and testing". For that reason simulation progra s control and data processing programs are especially prevalent in science and technical courses (see Härtel 1985).

- In the past the hardware components were treated relatively extensively in electrical courses in physics. The software components were secondary. In the meantime the contrary is true.
- If the portion of research and development is viewed in terms of the time involved, the research portion is more than minuscule. More than 95 % is development.
- Research covers nearly every sector that is treated in the Anglo-Saxon world, but with only a limited number of people involved in a certain topic. There are investigations about the effect of learning programming on problem solving (Schulz-Zander 1986); a survey of literature available on learning programming and problem solving, which leads to the conclusion that the effects are very specific and tied to the field in question (Mandl 1985); research about tutorial programs (Mandl 1985); interviews and questionnaires involving pupils who work with computers (e. g. Kanders 1985); investigations about the changes of student's concepts of information technology (Hansen 1985); Lehmann and Lauterbach (1985) have done a meta-analysis of the empirical investigations available using Dekkers and Donatti (1981), Kulik, Bangert and Williams (1983), Willet, Yamashita and Anderson (1983). In a number of publications the fact that according to these meta-analyses and their summaries the effect of computers is not clearly an improvement over not having computers was viewed as a surprise by most everyone.

In the Federal Republic of Germany the possibilities of using artificial intellegence are being investigated at several locations. The feeling is that the research in artificial intelligence (more for robots than for human learning?) will soon lead

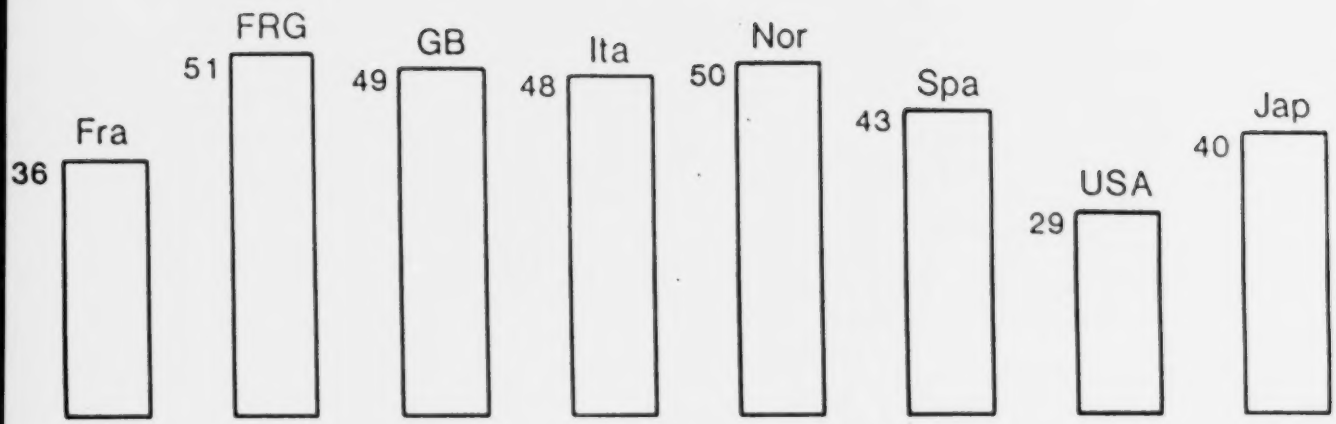
to results. Several analyses had to do with the new information technologies and the current curriculum structure in schools. These articles give special analysis of the genesis of new school subjects and areas like the new technologies (e.g. Künzli 1981 or Frey 1985). This is a short list of some of the excellent areas of research. The others, e.g. the teacher's role or application in various subject areas, are being treated in the same manner as in the Anglo-Saxon countries. It perhaps should be mentioned that special schools are being given special emphasis. The developments there are being pushed forward, especially with regard to research in educational psychology (see Hameyer et al. 1986).

Table 1:



I have already used a computer or a word processor.

Table 2:



I have never used one and I am not interested either.

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